

What is claimed is:

1. A pattern antenna comprising:

a first antenna pattern acting as a driven element and having an elongate pattern that is approximately in parallel with an edge of circumference of a grounding conductor portion provided on a circuit board; and a feeding pattern that connects a feeding point provided on the circuit board to the elongate pattern;

a second antenna pattern acting as a passive element, so formed as to be in close proximity to the first antenna pattern by surrounding the first antenna pattern, and having an elongate pattern that is approximately in parallel with the edge of circumference of the grounding conductor portion; and a grounding pattern that connects the grounding conductor portion to the elongate pattern;

wherein the pattern antenna is mounted on the circuit board.

2. A pattern antenna as claimed in claim 1,

wherein the first antenna pattern is an inverted-F-shaped antenna pattern, which is further provided with a grounding pattern that is formed at a different position from the feeding pattern, and which connects the grounding conductor portion to the elongate pattern, and

wherein the second antenna pattern is an inverted-L-shaped antenna pattern.

3. A pattern antenna as claimed in claim 1,

wherein the first antenna pattern is a loop-type antenna pattern, which is further provided with a grounding pattern that is formed at a different position from the feeding pattern or the grounding pattern, and which connects the grounding conductor portion to the

elongate pattern, and

wherein the second antenna pattern is an inverted-L-shaped antenna pattern.

4. A pattern antenna as claimed in claim 1,

wherein both the first antenna pattern and the second antenna pattern are inverted-L-shaped antenna patterns.

5. A pattern antenna as claimed in claim 1,

wherein, when frequencies for purpose of reception by the pattern antenna are f_1 and f_2 and wavelengths corresponding to the frequencies f_1 and f_2 are λ_1 and λ_2 ,

a path length of the first antenna pattern is more than $0.1 \lambda_1$ and $0.4 \lambda_1$ or less, and
a path length of the second antenna pattern is more than $0.1 \lambda_2$ and $0.4 \lambda_2$ or less.

6. A pattern antenna as claimed in claim 1,

wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,

a path length of the first antenna pattern is more than $0.3 \lambda_0$ and $0.5 \lambda_0$ or less, and
a path length of the second antenna pattern is more than $0.4 \lambda_0$ and $0.7 \lambda_0$ or less.

7. A pattern antenna as claimed in claim 1,

wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,

a conductor width of the first antenna pattern is more than $0.005 \lambda_0$ and $0.05 \lambda_0$ or less.

8. A pattern antenna as claimed in claim 1,
wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a conductor width of the second antenna pattern is more than $0.005 \lambda_0$ and $0.15 \lambda_0$ or less.

9. A pattern antenna as claimed in claim 1,
wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a space between the first antenna pattern and the second antenna pattern is more than $0.002 \lambda_0$ and $0.04 \lambda_0$ or less.

10. A pattern antenna as claimed in claim 1,
wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a height from the grounding conductor portion to the top edge of the second antenna pattern is more than $0.1 \lambda_0$ and $0.3 \lambda_0$ or less.

11. A pattern antenna as claimed in claim 1,
wherein a resonance frequency of the first antenna pattern differs from a resonance frequency of the second antenna pattern.

12. A pattern antenna as claimed in claim 1, further comprising:
at least one of third antenna patterns, that is installed in close proximity to other antenna patterns and is so formed as an inverted-L-shaped antenna pattern surrounding the

other antenna patterns, having an elongate pattern approximately in parallel with the edge of circumference of the grounding conductor portion of the circuit board and a grounding pattern connecting the elongate pattern to the grounding conductor portion, and that acts as a passive element.

13. A pattern antenna as claimed in claim 12,

wherein a resonance frequency of the third antenna pattern is approximately the same as a resonance frequency of the first antenna pattern or a resonance frequency of the second antenna pattern.

14. A pattern antenna as claimed in claim 12,

wherein a resonance frequency of at least one of the third antenna patterns is different from resonance frequencies of the first and the second antenna patterns.

15. A pattern antenna as claimed in claim 1,

wherein, when layers comprising the circuit board include a surface of the circuit board, all the antenna patterns are formed on a same layer of the circuit board.

16. A pattern antenna as claimed in claim 1,

wherein, when layers comprising the circuit board include a surface of the circuit board, at least one of the antenna patterns is formed on a layer of the circuit board which is different from layers having the other antenna patterns formed thereon.

17. A pattern antenna as claimed in claim 1, further comprising:

at least one of fourth antenna patterns having a same shape as a part or a whole of one of the antenna patterns;

wherein, when layers comprising the circuit board include a surface of the circuit board,

the fourth antenna pattern and the antenna patterns in the same shape as the fourth antenna pattern are formed on different layers and electrically connected to each other by way of through holes.

18. A pattern antenna as claimed in claim 1,

wherein, in at least one of the antenna patterns, at least one of the patterns included the antenna pattern is tapered.

19. A pattern antenna as claimed in claim 1,

wherein, in at least one of the antenna patterns, a conductor width of at least one of the patterns included the antenna pattern is different from the conductor width of the other patterns included the antenna pattern.

20. A pattern antenna as claimed in claim 1,

wherein, in at least one of the antenna patterns, at least one of the patterns included the antenna pattern is provided with a branch-shaped stub pattern.

21. A pattern antenna as claimed in claim 20,

wherein the stub pattern is provided in a neighborhood of the feeding point of the feeding pattern.

22. A pattern antenna as claimed in claim 20,

wherein the stub pattern is provided at a position in close proximity to an antenna pattern which is in close proximity to the antenna pattern having the stub pattern formed.

23. A pattern antenna as claimed in claim 20,
wherein the stub pattern is provided in parallel with the edge of circumference of the grounding conductor portion.

24. A pattern antenna as claimed in claim 23,
wherein the stub pattern is provided in a neighborhood of the feeding point of the feeding pattern.

25. A pattern antenna as claimed in claim 1,
wherein, in at least one of the antenna patterns, at least one of the patterns included the antenna pattern is partly or entirely formed in a meandering shape.

26. A pattern antenna as claimed in claim 1,
wherein at least one of the elongate patterns of any of the antenna patterns is shaped in a loop at an open end thereof.

27. A pattern antenna as claimed in claim 1,
wherein at least one of the elongate patterns of any of the antenna patterns is shaped in a patch which has a wider conductor width on an open end thereof.

28. A pattern antenna as claimed in claim 1,
wherein at least one of the elongate patterns of any of the antenna patterns is bent on an open end thereof.

29. A pattern antenna as claimed in claim 1,
wherein at least one of the antenna patterns is partly or entirely soldered.

30. A pattern antenna as claimed in claim 1,
wherein a circuit element is mounted on the circuit board, and
wherein a shield board covering the circuit element is provided on the grounding
conductor portion.

31. A pattern antenna as claimed in claim 1,
wherein a circuit element is mounted on a circuit board for circuitry different from the
circuit board, and
wherein the circuit board having the antenna patterns formed thereon is electrically
connected to the circuit board for circuitry by way of a coaxial cable.

32. A pattern antenna as claimed in claim 1,
wherein a circuit element is mounted on a circuit board for circuitry different from the
circuit board,
wherein the circuit board having the antenna patterns formed thereon is provided with
a first land pattern that is electrically connected to the grounding pattern and the feeding
pattern, and
wherein the circuit board for circuitry has a second land pattern that is connected to
the first land pattern formed thereon.

33. A pattern antenna as claimed in claim 32,
wherein the antenna patterns are constructed on a plurality of surfaces of the circuit
board.

34. A pattern antenna as claimed in claim 32,
wherein the circuit board having the antenna patterns formed thereon has the first land

pattern mounted on a surface thereof that is vertical to a surface having the antenna patterns formed thereon.

35. A pattern antenna as claimed in claim 1,

wherein a circuit element is mounted on a circuit board for circuitry different from the circuit board,

wherein the circuit board having the antenna patterns formed thereon is provided with a protruding electrode that is electrically connected to the grounding pattern and the feeding pattern of the antenna patterns, and

wherein the circuit board for circuitry has a through hole made thereon for the protruding electrode to be inserted into the through hole and electrically connected.

36. A pattern antenna as claimed in claim 35,

wherein the antenna patterns are formed on a plurality of surfaces of the circuit board.

37. A pattern antenna comprising:

a first antenna pattern acting as a passive element and having an elongate pattern that is approximately in parallel with an edge of circumference of a grounding conductor portion provided on a circuit board; and a grounding pattern that connects the grounding conductor portion to the elongate pattern;

a second antenna pattern acting as a driven element, so formed as to be in close proximity to the first antenna pattern by surrounding the first antenna pattern, and having an elongate pattern that is approximately in parallel with the edge of circumference of the grounding conductor portion; and a feeding pattern that connects a feeding point provided on the circuit board to the elongate pattern and;

wherein the pattern antenna is mounted on the circuit board.

38. A pattern antenna as claimed in claim 37,

wherein the first antenna pattern is an inverted-F-shaped antenna pattern, which is further provided with a grounding pattern that is formed at a different position from the grounding pattern, and which connects the grounding conductor portion to the elongate pattern, and

wherein the second antenna pattern is an inverted-L-shaped antenna pattern.

39. A pattern antenna as claimed in claim 37,

wherein the first antenna pattern is a loop-type antenna pattern, which is further provided with a grounding pattern that is formed at a different position from the grounding pattern, and which connects the grounding conductor portion to the elongate pattern, and

wherein the second antenna pattern is an inverted-L-shaped antenna pattern.

40. A pattern antenna as claimed in claim 37,

wherein both the first antenna pattern and the second antenna pattern are inverted-L-shaped antenna patterns.

41. A pattern antenna as claimed in claim 37,

wherein, when frequencies for purpose of reception by the pattern antenna are f_1 and f_2 and wavelengths corresponding to the frequencies f_1 and f_2 are λ_1 and λ_2 ,
a path length of the first antenna pattern is more than $0.1\lambda_1$ and $0.4\lambda_1$ or less, and
a path length of the second antenna pattern is more than $0.1\lambda_2$ and $0.4\lambda_2$ or less.

42. A pattern antenna as claimed in claim 37,

wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a path length of the first antenna pattern is more than $0.3\lambda_0$ and $0.5\lambda_0$ or less, and
a path length of the second antenna pattern is more than $0.4\lambda_0$ and $0.7\lambda_0$ or less.

43. A pattern antenna as claimed in claim 37,
wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a conductor width of the first antenna pattern is more than $0.005\lambda_0$ and $0.05\lambda_0$ or less.

44. A pattern antenna as claimed in claim 37,
wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a conductor width of the second antenna pattern is more than $0.005\lambda_0$ and $0.15\lambda_0$ or less.

45. A pattern antenna as claimed in claim 37,
wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a space between the first antenna pattern and the second antenna pattern is more than $0.002\lambda_0$ and $0.04\lambda_0$ or less.

46. A pattern antenna as claimed in claim 37,
wherein, when a center frequency of a frequency band for reception by the pattern

antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,

a height from the grounding conductor portion to the top edge of the second antenna pattern is more than $0.1 \lambda_0$ and $0.3 \lambda_0$ or less.

47. A pattern antenna as claimed in claim 37,

wherein a resonance frequency of the first antenna pattern differs from a resonance frequency of the second antenna pattern.

48. A pattern antenna as claimed in claim 37, further comprising:

at least one of third antenna patterns, that is installed in close proximity to other antenna patterns and is so formed as an inverted-L-shaped antenna pattern surrounding the other antenna patterns, having an elongate pattern approximately in parallel with the edge of circumference of the grounding conductor portion of the circuit board and a grounding pattern connecting the elongate pattern to the grounding conductor portion, and that acts as a passive element.

49. A pattern antenna as claimed in claim 48,

wherein a resonance frequency of the third antenna pattern is approximately the same as a resonance frequency of the first antenna pattern or a resonance frequency of the second antenna pattern.

50. A pattern antenna as claimed in claim 48,

wherein a resonance frequency of at least one of the third antenna patterns is different from resonance frequencies of the first and the second antenna patterns.

51. A pattern antenna as claimed in claim 37,

wherein, when layers comprising the circuit board include a surface of the circuit board, all the antenna patterns are formed on a same layer of the circuit board.

52. A pattern antenna as claimed in claim 37,

wherein, when layers comprising the circuit board include a surface of the circuit board, at least one of the antenna patterns is formed on a layer of the circuit board which is different from layers having the other antenna patterns formed thereon.

53. A pattern antenna as claimed in claim 37, further comprising:

at least one of fourth antenna patterns having a same shape as a part or a whole of one of the antenna patterns;

wherein, when layers comprising the circuit board include a surface of the circuit board,

the fourth antenna pattern and the antenna patterns in the same shape as the fourth antenna pattern are formed on different layers and electrically connected to each other by way of through holes.

54. A pattern antenna as claimed in claim 37,

wherein, in at least one of the antenna patterns, at least one of the patterns included the antenna pattern is tapered.

55. A pattern antenna as claimed in claim 37,

wherein, in at least one of the antenna patterns, a conductor width of at least one of the patterns included the antenna pattern is different from the conductor width of the other patterns included the antenna pattern.

56. A pattern antenna as claimed in claim 37,
wherein, in at least one of the antenna patterns, at least one of the patterns included the antenna pattern is provided with a branch-shaped stub pattern.

57. A pattern antenna as claimed in claim 56,
wherein the stub pattern is provided in a neighborhood of the feeding point of the feeding pattern.

58. A pattern antenna as claimed in claim 56,
wherein the stub pattern is provided at a position in close proximity to an antenna pattern which is in close proximity to the antenna pattern having the stub pattern formed.

59. A pattern antenna as claimed in claim 56,
wherein the stub pattern is provided in parallel with the edge of circumference of the grounding conductor portion.

60. A pattern antenna as claimed in claim 59,
wherein the stub pattern is provided in a neighborhood of the feeding point of the feeding pattern.

61. A pattern antenna as claimed in claim 37,
wherein, in at least one of the antenna patterns, at least one of the patterns included the antenna pattern is partly or entirely formed in a meandering shape.

62. A pattern antenna as claimed in claim 37,
wherein at least one of the elongate patterns of any of the antenna patterns is shaped in

a loop at an open end thereof.

63. A pattern antenna as claimed in claim 37,

wherein at least one of the elongate patterns of any of the antenna patterns is shaped in a patch which has a wider conductor width on an open end thereof.

64. A pattern antenna as claimed in claim 37,

wherein at least one of the elongate patterns of any of the antenna patterns is bent on an open end thereof.

65. A pattern antenna as claimed in claim 37,

wherein at least one of the antenna patterns is partly or entirely soldered.

66. A pattern antenna as claimed in claim 37,

wherein a circuit element is mounted on the circuit board, and

wherein a shield board covering the circuit element is provided on the grounding conductor portion.

67. A pattern antenna as claimed in claim 37,

wherein a circuit element is mounted on a circuit board for circuitry different from the circuit board, and

wherein the circuit board having the antenna patterns formed thereon is electrically connected to the circuit board for circuitry by way of a coaxial cable.

68. A pattern antenna as claimed in claim 37,

wherein a circuit element is mounted on a circuit board for circuitry different from the

circuit board,

wherein the circuit board having the antenna patterns formed thereon is provided with a first land pattern that is electrically connected to the grounding pattern and the feeding pattern, and

wherein the circuit board for circuitry has a second land pattern that is connected to the first land pattern formed thereon.

69. A pattern antenna as claimed in claim 68,

wherein the antenna patterns are constructed on a plurality of surfaces of the circuit board.

70. A pattern antenna as claimed in claim 68,

wherein the circuit board having the antenna patterns formed thereon has the first land pattern mounted on a surface thereof that is vertical to a surface having the antenna patterns formed thereon.

71. A pattern antenna as claimed in claim 37,

wherein a circuit element is mounted on a circuit board for circuitry different from the circuit board,

wherein the circuit board having the antenna patterns formed thereon is provided with a protruding electrode that is electrically connected to the grounding pattern and the feeding pattern of the antenna patterns, and

wherein the circuit board for circuitry has a through hole made thereon for the protruding electrode to be inserted into the through hole and electrically connected.

72. A pattern antenna as claimed in claim 71,

wherein the antenna patterns are formed on a plurality of surfaces of the circuit board.

73. A pattern antenna comprising:

a first antenna pattern antenna which is a loop-type antenna pattern, provided with an elongate pattern that is approximately in parallel with an edge of circumference of a grounding conductor portion mounted on a circuit board; a feeding pattern that connects a feeding point provided on the circuit board to the elongate pattern; and a grounding pattern that connects the grounding conductor portion to the elongate pattern;

a second antenna pattern which is an inverted-L-shaped antenna pattern, provided with an elongate pattern that is approximately in parallel with the edge of circumference of the grounding conductor portion; and a grounding pattern that connects the grounding conductor portion to the elongate pattern;

wherein the circuit board consists of a plurality of layers including a surface of the circuit board;

wherein the first antenna pattern and the second antenna pattern are formed on different layers; and

wherein the first antenna pattern and the second antenna pattern are so formed as to overlap each other.

74. A pattern antenna as claimed in claim 73,

wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,

a path length of the first antenna pattern is more than $0.3\lambda_0$ and $0.5\lambda_0$ or less, and

a path length of the second antenna pattern is more than $0.4\lambda_0$ and $0.7\lambda_0$ or less.

75. A pattern antenna as claimed in claim 73

wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a conductor width of the first antenna pattern is more than $0.005 \lambda_0$ and $0.05 \lambda_0$ or less.

76. A pattern antenna as claimed in claim 73,

wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a conductor width of the second antenna pattern is more than $0.005 \lambda_0$ and $0.15 \lambda_0$ or less.

77. A pattern antenna as claimed in claim 73,

wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a space between the first antenna pattern and the second antenna pattern is more than $0.002 \lambda_0$ and $0.04 \lambda_0$ or less.

78. A pattern antenna as claimed in claim 73,

wherein, when a center frequency of a frequency band for reception by the pattern antenna is f_0 and a wavelength corresponding to the frequency f_0 is λ_0 ,
a height from the grounding conductor portion to the top end of the second antenna pattern is more than $0.1 \lambda_0$ and $0.3 \lambda_0$ or less.

79. A pattern antenna as claimed in claim 73,

wherein a resonance frequency of the first antenna pattern differs from a resonance frequency of the second antenna pattern.

80. A pattern antenna as claimed in claim 73, further comprising:

at least one of third antenna patterns, that is installed in close proximity to other antenna patterns and is so formed as an inverted-L-shaped antenna pattern surrounding the other antenna patterns, having an elongate pattern approximately in parallel with an edge of circumference of a grounding conductor portion of the circuit board and a grounding pattern connecting the elongate pattern to the grounding conductor portion, and that acts as a passive element.

81. A pattern antenna as claimed in claim 80,

wherein a resonance frequency of the third antenna pattern is approximately the same as a resonance frequency of the first antenna pattern or a resonance frequency of the second antenna pattern.

82. A pattern antenna as claimed in claim 80,

wherein a resonance frequency of one of the third antenna patterns is different from resonance frequencies of the first and the second antenna patterns.

83. A pattern antenna as claimed in claim 73, further comprising:

at least one of fourth antenna patterns having a same shape as a part or a whole of one of the antenna patterns;

wherein the fourth antenna pattern and the antenna patterns in the same shape as the fourth antenna pattern are formed on different layers and electrically connected to each other by way of through holes.

84. A pattern antenna as claimed in claim 73,
wherein, in at least one of the antenna patterns, at least one of the patterns included the antenna pattern is tapered.

85. A pattern antenna as claimed in claim 73,
wherein, in at least one of the antenna patterns, a conductor width of at least one of the patterns included the antenna pattern is different from the conductor width of the other patterns included the antenna pattern.

86. A pattern antenna as claimed in claim 73,
wherein, in at least one of the antenna patterns, at least one of the patterns included the antenna pattern is provided with a branch-shaped stub pattern.

87. A pattern antenna as claimed in claim 86,
wherein the stub pattern is provided in a neighborhood of the feeding point of the feeding pattern.

88. A pattern antenna as claimed in claim 86,
wherein the stub pattern is provided at a position in close proximity to an antenna pattern which is in close proximity to the antenna pattern having the stub pattern formed.

89. A pattern antenna as claimed in claim 86,
wherein the stub pattern is provided in parallel with the edge of circumference of the grounding conductor portion.

90. A pattern antenna as claimed in claim 89,

wherein the stub pattern is provided in a neighborhood of the feeding point of the feeding pattern.

91. A pattern antenna as claimed in claim 73,

wherein, in at least one of the antenna patterns, at least one of the patterns included the antenna pattern is partly or entirely formed in a meandering shape.

92. A pattern antenna as claimed in claim 73,

wherein at least one of the elongate patterns of any of the antenna patterns is shaped in a loop at an open end thereof.

93. A pattern antenna as claimed in claim 73,

wherein at least one of the elongate patterns of any of the antenna patterns is shaped in a patch which has a wider conductor width on an open end thereof.

94. A pattern antenna as claimed in claim 73,

wherein at least one of the elongate patterns of any of the antenna patterns is bent on an open end thereof.

95. A pattern antenna as claimed in claim 73,

wherein at least one of the antenna patterns is partly or entirely soldered.

96. A pattern antenna as claimed in claim 73,

wherein a circuit element is mounted on the circuit board, and

wherein a shield board covering the circuit element is provided on the grounding conductor portion.

97. A pattern antenna as claimed in claim 73,
wherein a circuit element is mounted on a circuit board for circuitry different from the circuit board, and
wherein the circuit board having the antenna patterns formed thereon is electrically connected to the circuit board for circuitry by way of a coaxial cable.

98. A pattern antenna as claimed in claim 73,
wherein a circuit element is mounted on a circuit board for circuitry different from the circuit board,
wherein the circuit board having the antenna patterns formed thereon is provided with a first land pattern that is electrically connected to the grounding pattern and the feeding pattern, and
wherein the circuit board for circuitry has a second land pattern that is connected to the first land pattern formed thereon.

99. A pattern antenna as claimed in claim 98,
wherein the antenna patterns are constructed on a plurality of surfaces of the circuit board.

100. A pattern antenna as claimed in claim 98,
wherein, the circuit board having the antenna patterns formed thereon has the first land pattern mounted on a surface thereof that is vertical to a surface having the antenna patterns formed thereon.

101. A pattern antenna as claimed in claim 73,
wherein a circuit element is mounted on a circuit board for circuitry different from the

circuit board,

wherein the circuit board having the antenna patterns formed thereon is provided with a protruding electrode that is electrically connected to the grounding pattern and the feeding pattern of the antenna patterns, and

wherein the circuit board for circuitry has a through hole made thereon for the protruding electrode to be inserted into the through hole and electrically connected.

102. A pattern antenna as claimed in claim 101,

wherein the antenna patterns are formed on a plurality of surfaces of the circuit board.